REMARKS

Review and reconsideration on the merits are requested.

Restriction

Applicant affirms his election of Group I, claims 1-17.

The Priority Claim

The priority document was filed in this application on March 26, 2004.

The Examiner is requested to acknowledge receipt.

The Prior Art

JP 06-322517 Masumoto (Masumoto, which should be Matsumoto); US 6,730,392 Vetter et al (Vetter); US 6,586,122 Ishikawa et al (Ishikawa); Oxidation Behavior...Pulsed Laser Deposition Hirai et al (Hirai).

The Rejections

Claims 1, 9, 12 and 15 under 35 U.S.C. § 102(b) as anticipated by Hirai or Matsumoto.

Claims 1, 9, 12 and 15 under 35 U.S.C. § 102(e) as anticipated by Vetter.

Claims 1-17 under 35 U.S.C. § 102(e) as anticipated by Ishikawa.

The Examiner's brief position on the rejections is set forth in the Action.

Applicant's traverse is set forth below.

Traversal

Rejection Over Hirai or Masumoto

Claim 1 of the present application calls for:

"A hard film formed by an arc-discharge ion-planting method, having a composition comprising metal components represented by Al_xCr_{1-x}, wherein x is an atomic ratio meeting $0.45 \leq x \leq 0.75$, and non-metal components represented by $N_{1-\alpha-\beta-\gamma}B_\alpha C_\beta O_\gamma$, wherein α, β and γ are respectively atomic ratios meeting $0 \leq \alpha \leq 0.15$, $0 \leq \beta \leq 0.35$, and $0.01 \leq \gamma \leq 0.25$; said hard film having the maximum X-ray diffraction intensity in a (200) face or a (111) face, and the binding energy of Al and/or Cr to oxygen in a range of 525-535 eV in an X-ray photoelectron spectroscopy."

In contrast, Hirai discloses a chromium aluminum oxynitride film having the composition $Cr_{0.11}Al_{0.39}N_{0.25}O_{0.25}$ (Abstract; paragraph bridging the left column to the right column at page 123; Fig. 1 at page 123 of Hirai), where the atomic ratio x of Al in Al_xCr_{1-x} is 0.78. Thus, the atomic ratio of Al in Hirai falls outside the atomic ratio of $0.45 \leq x \leq 0.75$ in Al_xCr_{1-x} as required in the invention claimed herein.

Applicant wishes to emphasize the following important differences between the present invention and Hirai. A hard film having a composition comprising metal components represented by Al_xCr_{1-x} and non-metal components represented by $N_{1-\alpha-\beta-\gamma}B_\alpha C_\beta O_\gamma$ is claimed herein. When the amount x of Al is less than 0.45, insufficient effects of improving hardness and high-temperature oxidation resistance of the hard film are achieved. On the other hand, when x exceeds 0.75, the hard film has excess residual compression stress, resulting in self-destruction immediately after coating and a consequent drastic decrease in strength. The preferred range of x is 0.5-0.7 (see page 6, lines 23-28 of the specification).

Further, in the claimed invention the amount γ of oxygen in $N_{1-\alpha-\beta-\gamma}B_\alpha C_\beta O_\gamma$ should be 0.01-0.25. When γ is less than 0.01, the addition of oxygen does not provide sufficient effects.

On the other hand, when γ exceeds 0.25, the film has extremely decreased hardness, resulting in poor wear resistance. γ is preferably 0.01-0.2, particularly 0.02-0.2 (see page 7, lines 10-20 of the specification), which is far less than γ=0.5 in the chromium aluminum oxynitride film of Hirai.

Hirai does not teach or suggest a hard film having a composition comprising metal components represented by Al_xCr_{1-x}, wherein x is an atomic ratio meeting $0.45 \le x \le 0.75$, and non-metal components represented by $N_{1-\alpha-\beta-\gamma}B_\alpha C_\beta O_\gamma$, wherein γ is an atomic ratio meeting $0.01 \le \gamma \le 0.25$.

Accordingly, claim 1 is not anticipated by Hirai nor does Hirai provide any motivation to one of ordinary skill in the art to reach claim 1.

Withdrawal of the rejection over Hirai is requested.

Applicants now turn to Matsumoto. Matsumoto discloses a wear resistant amorphous hard film formed on a substrate in an inert gaseous atmosphere by physical deposition using an evaporating source material having the composition $Al_\alpha Cr_{1-a}$, wherein α is $0.68 \le a \le 0.985$ (see Abstract of Matsumoto attached). Matsumoto does not teach the composition of the amorphous hard film obtained. Moreover, the hard film or Matsumoto has an amorphous structure, which is different from that of the claimed invention in crystal structure having a maximum X-ray diffraction intensity in a (200) face or a (111) face.

Matsumoto thus does not teach or suggest a hard film having a composition comprising metal components represented by Al_xCr_{1-x}, wherein x is an atomic ratio meeting $0.45 \le x \le 0.75$,

which also exhibits a crystal structure having the maximum X-ray diffraction intensity in a (200) face or a (111) face.

In light of the above, Matsumoto does not anticipate claim 1. Further, there is no motivation of record which would lead one of ordinary skill in the art to reach the subject matter of claim 1 from the teaching of Masumoto.

Applicant relies upon the above arguments for the patentability of claims 9, 12 and 15. Withdrawal is requested.

Rejection Based on Vetter

Vetter discloses a hard layer containing Al, Ti, Cr, N and O, which is characterized by chemical analysis as: $(Al_aTi_bCr_c)$ (N_wO_{100-w}), where $30 \leq a \leq 70$, $30 \leq b \leq 70$, $0.5 \leq c \leq 20$, $a+b+c=100$, $70 \leq w \leq 99$ (see claim 1, and column 1, lines 40-46 of Vetter).

Since b is not zero ($b \neq 0$), the composition of the hard layer of Vetter, which has Ti as an indispensable element, is different from a composition comprising metal components of Al and Cr of the claimed invention.

Thus, Vetter does not teach or suggest a hard film having a composition comprising metal components represented by Al_xCr_{1-x}, wherein x is an atomic ratio meeting $0.45 \leq x \leq 0.75$.

Accordingly, Vetter cannot anticipate claim 1. Further, there is no motivation in Vetter to modify the Vetter composition to reach the subject matter of claim 1 herein.

With respect to claims 9, 12 and 15, Applicant relies upon the arguments regarding claim 1 for purposes of patentability.

Withdrawal is requested.

Rejection Based on Ishikawa

Ishikawa discloses a multilayer-coated cutting tool comprising a cutting tool substrate, and a multilayer coating film. The multilayer film comprises a first had coating film on the substrate and a second hard coating film formed on the first hard coating film.

The first hard coating film comprises one or more metallic elements selected from the group consisting of Ti, Al and Cr, and one or more non-metallic elements selected from the group consisting of N, B, C and O.

The second hard coating film comprises Si and one or more metallic elements selected from the group consisting of metallic elements of Groups 4a, 5a and 6a of the Periodic Table and Al, and one or more non-metallic elements selected form the group consisting of N, B, C and O. The second hard coating film is a composition-segregated polycrystalline film comprising a phase having a relatively high Si concentration and a phase having a relatively low Si concentration (see Abstract of Ishikawa).

Thus, major features of Ishikawa are found in a multilayer coating film composed of a Si-containing coating film which has a structure in which Si-rich, hard crystal grains are dispersed in a matrix constituted by a phase containing a relatively small amount of Si (see column 2, lines 26-35 of Ishikawa).

In contrast to Ishikawa, the hard film of claim 1 herein does not contain Si as an indispensable element. Further, the hard film herein is characterized by a maximum X-ray diffraction intensity in a (200) face or a (111) face and a binding energy of Al and/or Cr to

oxygen in a range of 525-535 eV by X-ray photoelectron spectroscopy. Such features are entirely different from those of the multilayer coating film of Ishikawa.

Ishikawa thus does not teach or suggest a hard film having a composition comprising metal components represented by Al_xC_{1-x}, wherein x is an atomic ratio meeting $0.45 \leq x \leq 0.75$ or a maximum X-ray diffraction intensity and a binding energy of Al and/or Cr to oxygen.

Accordingly, Ishikawa cannot anticipate claim 1. Further, Ishikawa provides no motivation for one ordinary skill in the art to be led to the subject matter of claim 1.

Claim 2 of the present application calls for: "A hard film formed by an arc-discharge ion-plating method, having a composition comprising metal components represented by $Al_xCr_{1-x-y}Si_y$, wherein x and y are respectively atomic ratios meeting $0.45 \leq x \leq 0.75$, and $0 < y \leq 0.35$, and non-metal components represented by $N_{1-\alpha-\beta-\gamma}B_\alpha C_\beta O_\gamma$, wherein α, β and γ are respectively atomic ratios meeting $0 \leq \alpha \leq 0.15$, $0 \leq \beta \leq 0.35$, and $\gamma \leq 0.25$; said hard film having the binding energy of Al, Cr and /or Si to oxygen in a range of 525-535 eV in an X-ray photoelectron spectroscopy".

The features of claim 2 are different from those of the multilayer coating film of Ishikawa in defining the binding energy of Al, Cr and/or Si to oxygen, though Si may be present.

Accordingly, since Ishikawa does not teach a hard film meeting the binding energy limits of claim 2, and as there is no motivation for one of ordinary skill in the art to reach such binding limits, withdrawal if requested.

Claim 5 of the present application calls for: "A hard film formed by an arc-discharge ion-plating method, having a composition comprising metal components represented by $Al_xCr_{1-x-y}Si_y$, wherein x and $y$are respectively atomic ratios meeting $0.45 \leq x \leq 0.75$, $0 \leq y \leq 0.35$, and $0.5 \leq x+y < 1$,

and non-metal components represented by $N_{1-\alpha-\beta-\gamma}B_{\alpha}C_{\beta}O_{\gamma}$, wherein α, β and γ are respectively atomic ratios meeting $0\leq\alpha\leq0.15$, $0\leq\beta\leq0.35$, and $0.003\leq\gamma\leq0.25$; said hard film having an NaCl-type crystal structure in an X-ray diffraction, with a half width of 2θ at a diffraction peak corresponding to a (111) face or a (200) face being 0.5-2.0°; and said hard film containing oxygen more in grain boundaries than in crystal grains."

The features of claim 5 are quite different from those of the multilayer coating film of Ishikawa in reciting an Na-Cl type crystal structure, a half width of 2θ at an X-ray diffraction peak, and oxygen existing more in grain boundaries than in crystal grains in the hard film, even though Si may be present.

Therefore, those skilled in the art referring to Ishikawa would see Ishikawa does not teach or suggest any hard film having an NaCl-type crystal structure, a half width of 2θ at an X-ray diffraction peak, and oxygen existing more in grain boundaries than in crystal grains in the hard film.

Thus, Ishikawa cannot anticipate claim 5 nor does Ishikawa contain motivation which would lead one of ordinary skill in the art to claim 5.

Regarding claims 9, 12 and 15, Applicant relies upon his arguments regarding claim 1 for purposes of patentability.

Regarding claims 3, 4, 10, 13 and 16, Applicant relies upon the arguments regarding claim 2 for purposes of patentability.

Regarding claims 6, 7, 8, 11, 14 and 17, Applicant relies upon the arguments regarding claim 5 for purposes of patentability.

Withdrawal of all rejections and allowance is requested.

One sheet of PATENT ABSTRACTS OF JAPAN regarding 06-322,517 is attached.

Respectfully submitted,

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(30)Priority

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(54) WEAR RESISTANT AMORPHOUS HARD FILM AND ITS PRODUCTION

(57)Abstract:

PURPOSE: To form a wear resistant amorphous hard film having denseness, excellent adhesion to the substrate, high bending strength and high hardness in a relatively easy process.

CONSTITUTION: An amorphous film is formed on a substrate in an inert gaseous amtosphere contg. a prescribed amt. of reactive gas by physical vapor deposition such as sputtering or ion plating with an evaporating source material having a compsn. represented by a general formula AlaMb (where M is at least one kind of element selected among Ti, Ta, V, Cr, Zx, Nb, Mo, Hf, W, Fe, Co, Ni, Cu and Mn, (a) is 60-98.5atomic%, (b) is 1.5-40atomic% and a+b=100atomic%) while feeding reactive gas contg. nitrogen, oxygen or carbon.

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